Fig. 1a

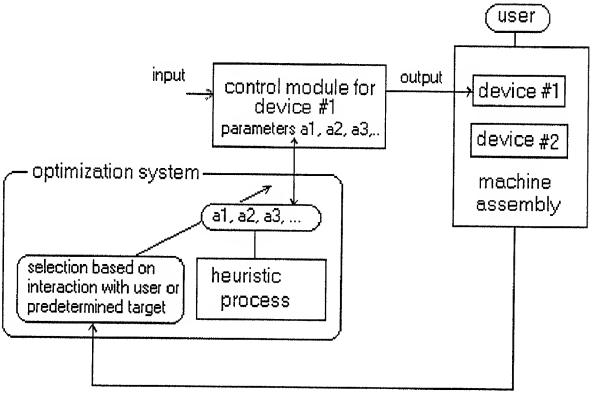

user
input
control module for device #1
parameters a1, a2, a3,..
output
device #1
device #2
machine assembly
optimization system
a1, a2, a3, ...
selection based on interaction with user or predetermined target
heuristic process

Fig. 1b

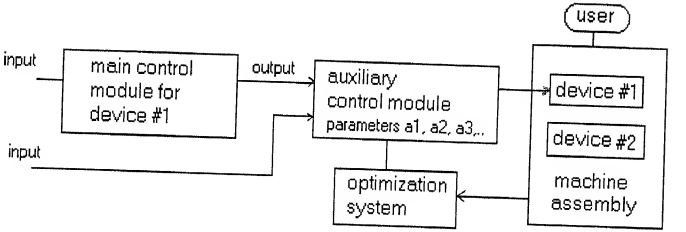

user
input
main control module for device #1
output
auxiliary control module
parameters a1, a2, a3,..
device #1
device #2
machine assembly
input
optimization system

Fig. 1c

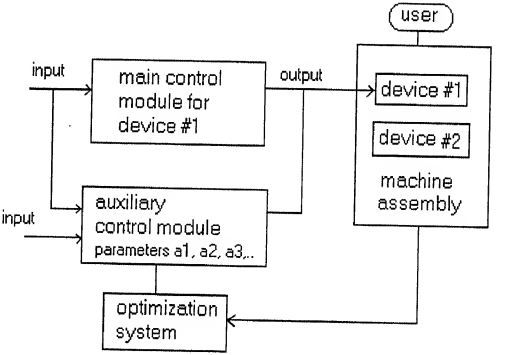

user
input
main control module for device #1
output
device #1
device #2
machine assembly
input
auxiliary control module
parameters a1, a2, a3,..
optimization system

Fig. 1d

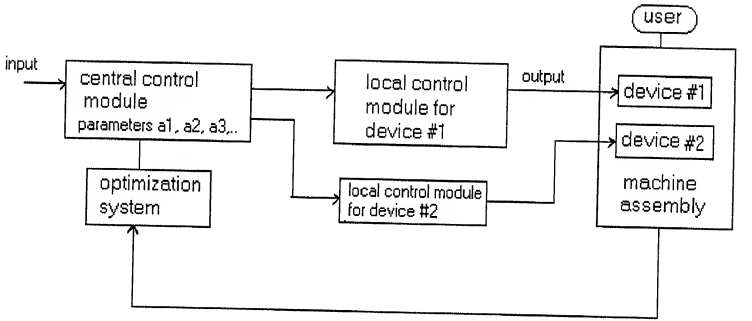
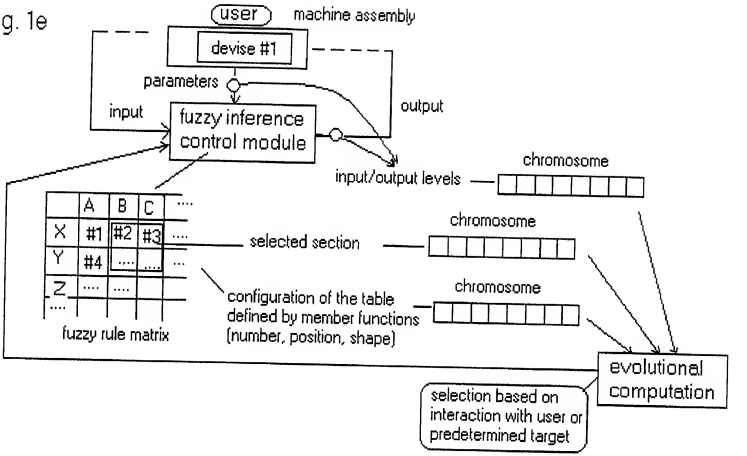

user
input
central control module
parameters a1, a2, a3,..
local control module for device #1
output
device #1
device #2
machine assembly
optimization system
local control module for device #2

Fig. 1e


user
machine assembly
devise #1
parameters
input
fuzzy inference control module
output
input/output levels
chromosome
A
B
C
X
Y
Z
#1
#2
#3
#4
selected section
chromosome
configuration of the table defined by member functions (number, position, shape)
chromosome
fuzzy rule matrix
evolutional computation
selection based on interaction with user or predetermined target

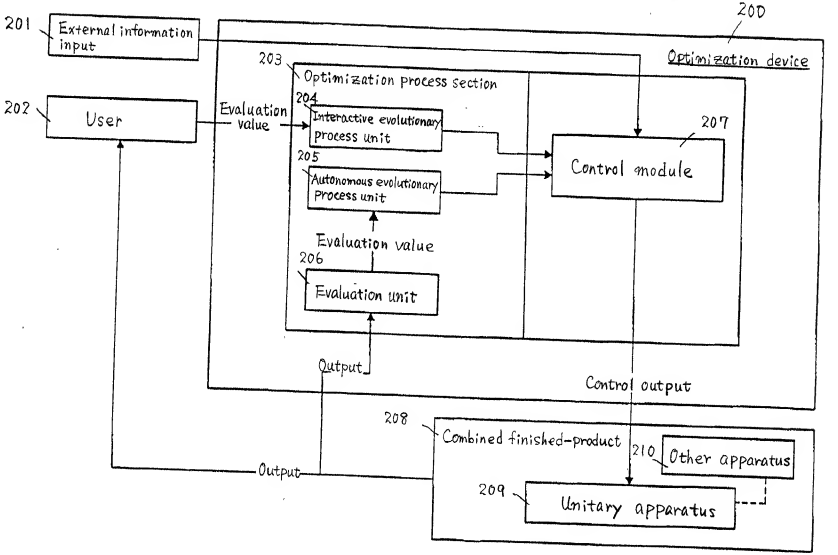

201
External information input
200
Optimization device
203
Optimization process section
202
User
Evaluation value
204
Interactive evolutionary Process unit
207
Control module
205
Autonomous evolutionary Process unit
Evaluation value
206
Evaluation unit
Output
Control output
208
Combined finished-product
210
Other apparatus
Output
209
Unitary apparatus

FIG. 2

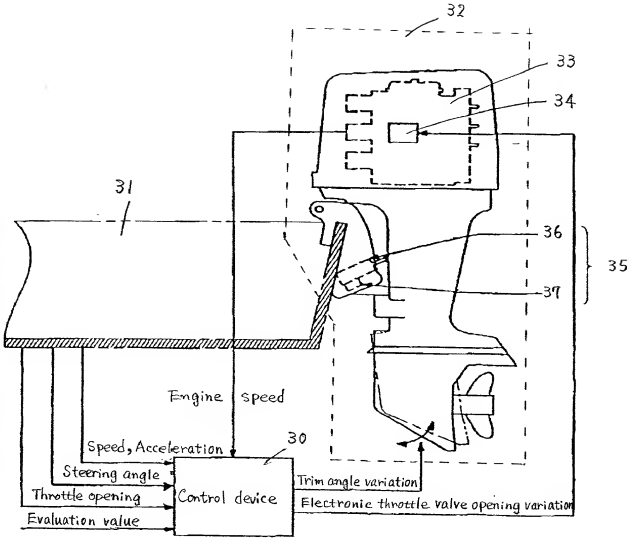

32
33
34
31
36
35
37
Engine speed
Speed, Acceleration
30
Steering angle
Throttle opening
Evaluation value
Control device
Trim angle variation
Electronic throttle valve opening variation

FIG. 3

US 6,827,620 B2

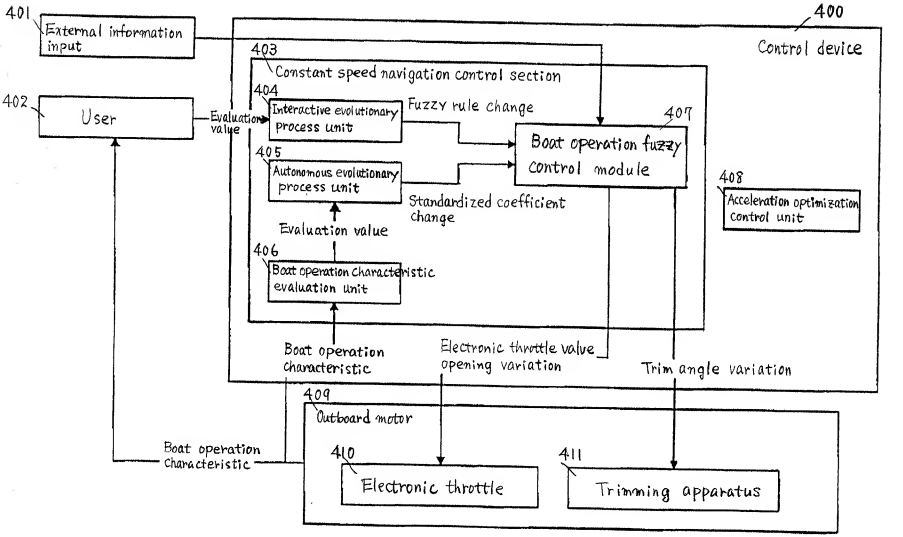


FIG. 4

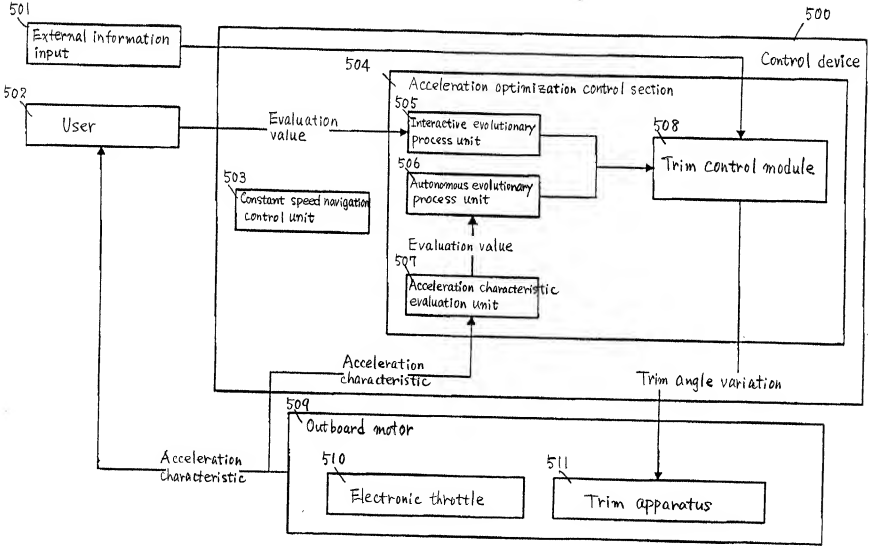
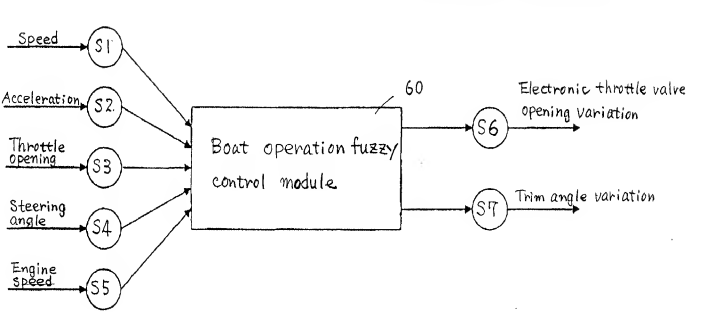

501
External information input
500
Control device
504
Acceleration optimization control section
502
User
Evaluation value
505
Interactive evolutionary process unit
508
Trim control module
506
Autonomous evolutionary process unit
503
Constant speed navigation control unit
Evaluation value
507
Acceleration characteristic evaluation unit
Acceleration characteristic
Trim angle variation
509
Outboard motor
Acceleration characteristic
510
Electronic throttle
511
Trim apparatus

FIG. 5

DOTOCL: 1611222260



S1	S2	S3	S4	S5	S6	S7

FIG. 6

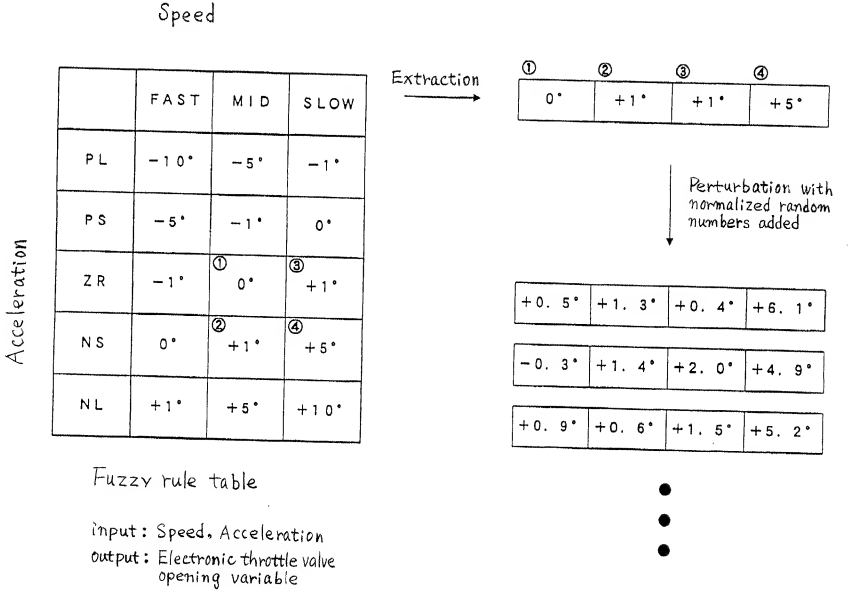

Speed
Acceleration
FAST
MID
SLOW
PL
PS
ZR
NS
NL
−10°
−5°
−1°
−5°
−1°
0°
−1°
① 0°
③ +1°
② +1°
④ +5°
0°
+5°
+10°
Extraction
① ② ③ ④
0° +1° +1° +5°
Perturbation with normalized random numbers added
+0. 5° +1. 3° +0. 4° +6. 1°
−0. 3° +1. 4° +2. 0° +4. 9°
+0. 9° +0. 6° +1. 5° +5. 2°
Fuzzy rule table
Input: Speed, Acceleration
Output: Electronic throttle valve opening variable

FIG. 7

00:02:07 hei.2250

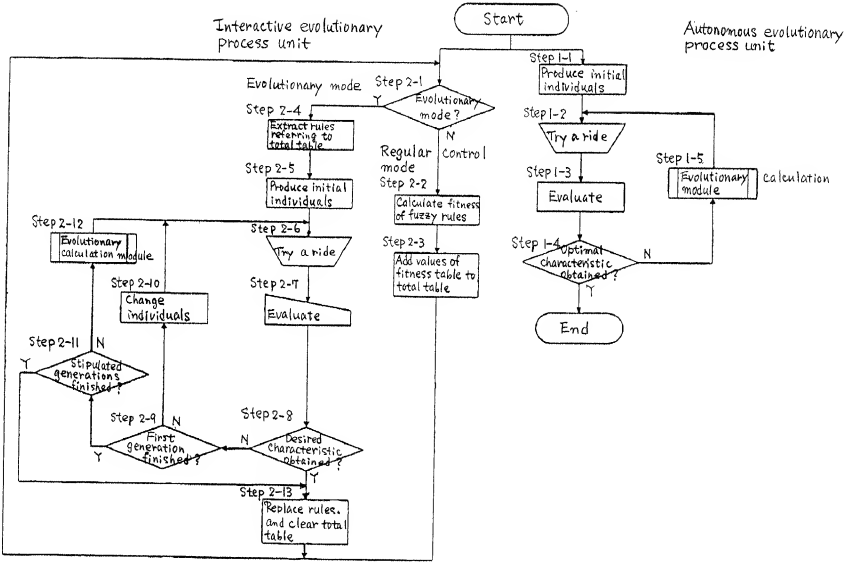


FIG. 8

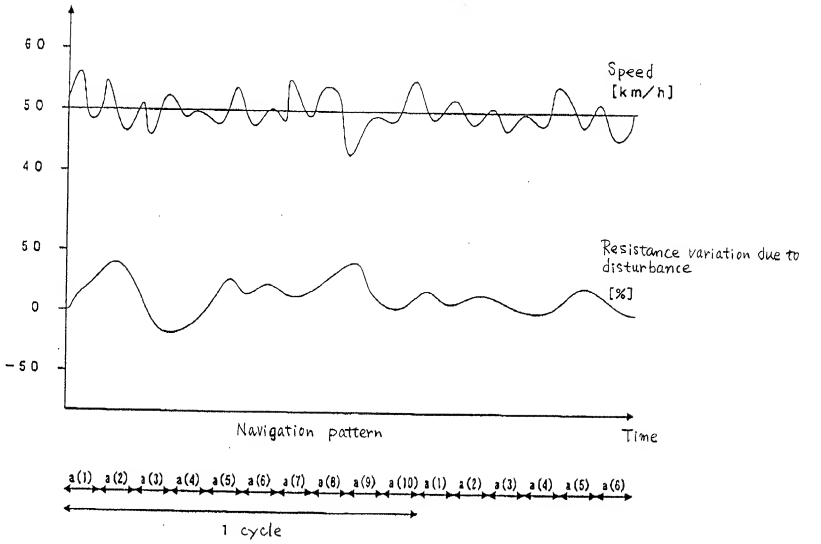

60
50
40
50
0
-50
Speed
[km/h]
Resistance variation due to disturbance
[%]
Navigation pattern
Time
a(1) a(2) a(3) a(4) a(5) a(6) a(7) a(8) a(9) a(10) a(1) a(2) a(3) a(4) a(5) a(6)
1 cycle

FIG. 9

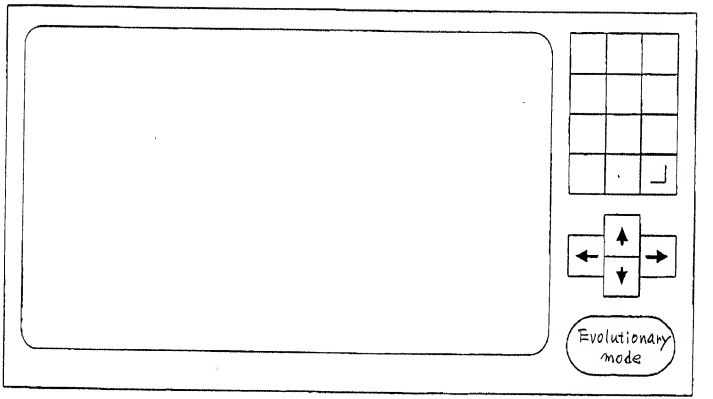


FIG. 10

0010217 "EP1272260

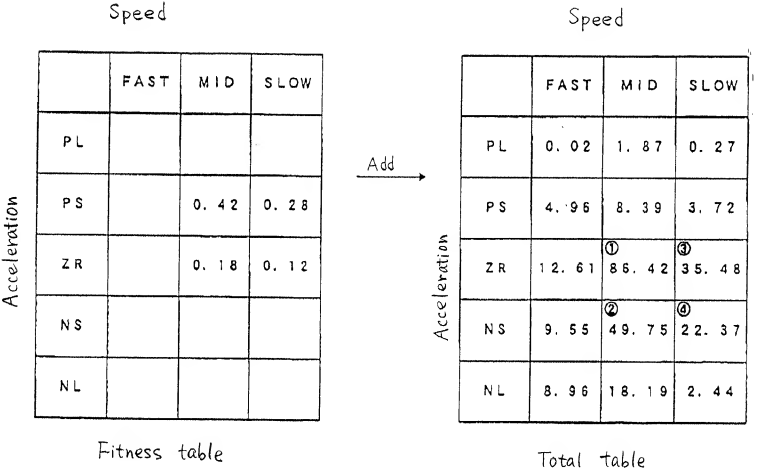


FIG. 11

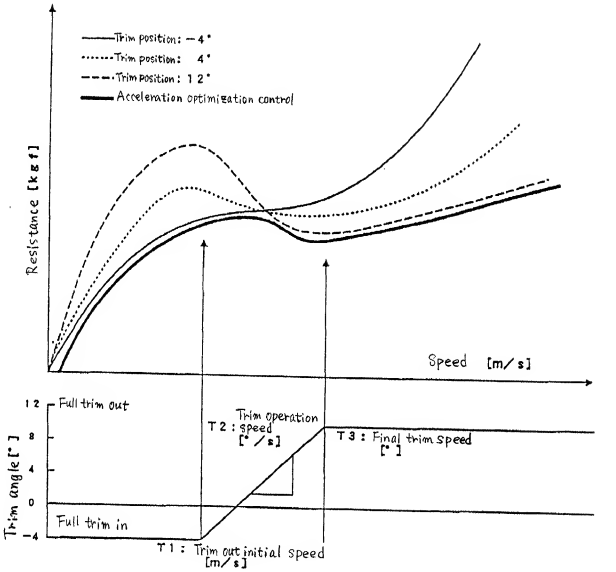

Trim position: −4°
Trim position: 4°
Trim position: 12°
Acceleration optimization control
Resistance [kgf]
Speed [m/s]
12
8
4
0
−4
Trim angle [°]
Full trim out
Full trim in
Trim operation
T2 : speed
[°/s]
T3 : Final trim speed
[°]
T1 : Trim out initial speed
[m/s]

FIG. 12

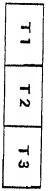

T1
T2
T3

FIG. 13

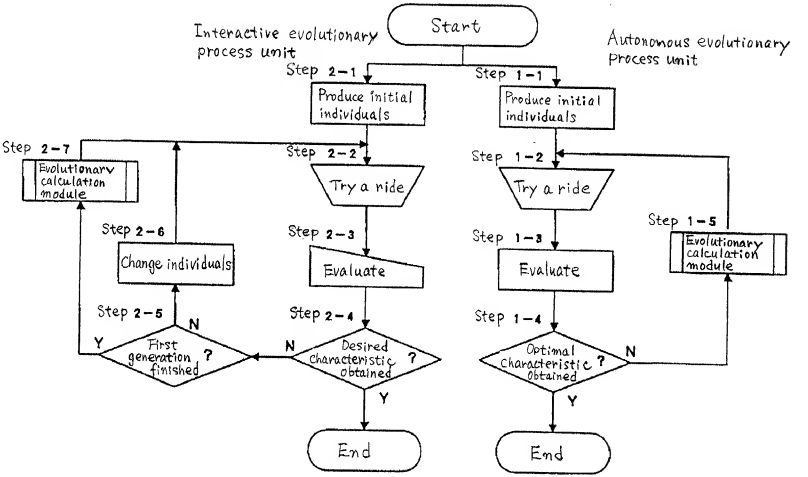

Start
Interactive evolutionary process unit
Autonomous evolutionary process unit
Step 2-1
Produce initial individuals
Step 1-1
Produce initial individuals
Step 2-7
Evolutionary calculation module
Step 2-2
Try a ride
Step 1-2
Try a ride
Step 1-5
Evolutionary calculation module
Step 2-6
Change individuals
Step 2-3
Evaluate
Step 1-3
Evaluate
Step 2-5
First generation finished ?
Step 2-4
Desired characteristic obtained ?
Step 1-4
Optimal characteristic obtained ?
Y
N
End
End

FIG. 14

JP2021-152620

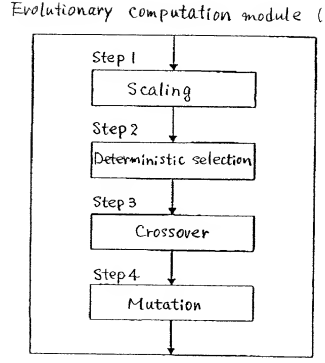


FIG. 15

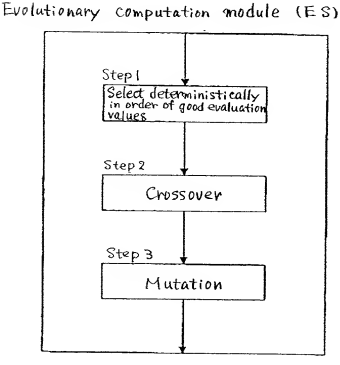


FIG. 16

Evolutionary Computation module (EP)

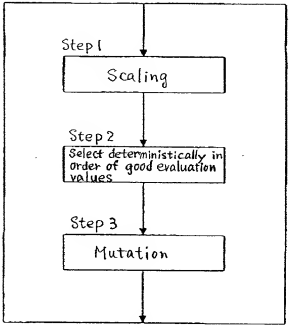


FIG. 17

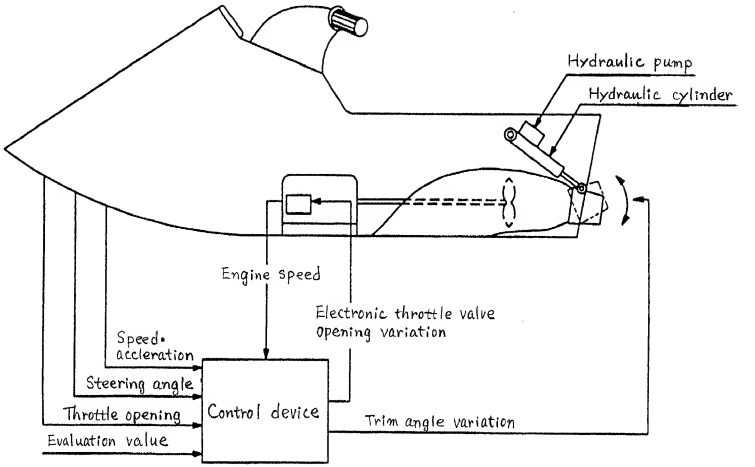

Hydraulic pump
Hydraulic cylinder
Engine speed
Electronic throttle valve
Opening variation
Speed•
accleration
Steering angle
Throttle opening
Evaluation value
Control device
Trim angle variation

FIG. 18

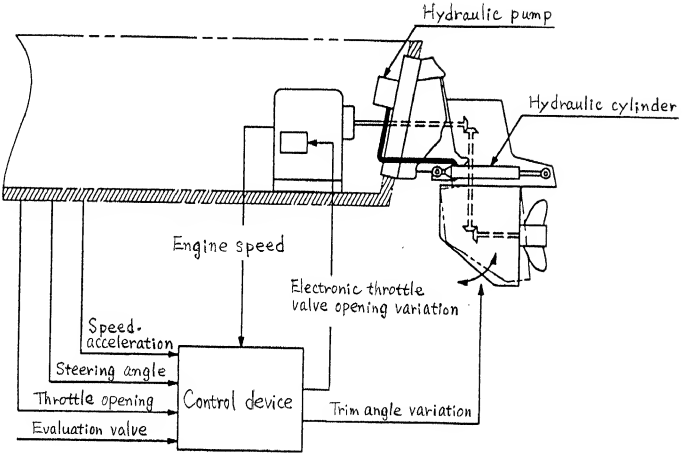

Hydraulic pump
Hydraulic cylinder
Engine speed
Electronic throttle valve opening variation
Speed-acceleration
Steering angle
Throttle opening
Evaluation valve
Control device
Trim angle variation

FIG. 19

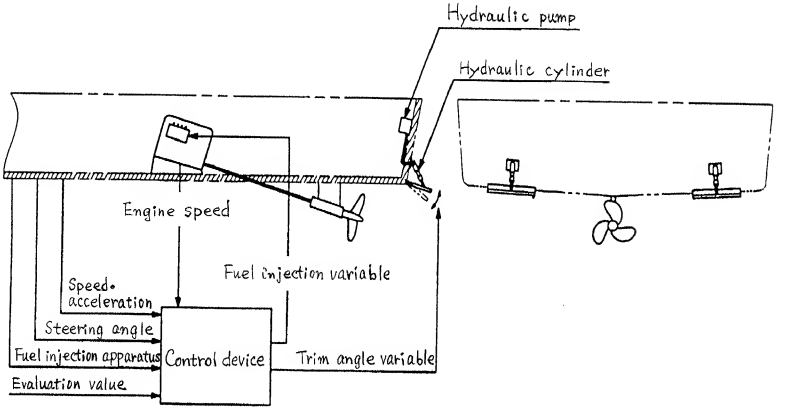

Hydraulic pump
Hydraulic cylinder
Engine speed
Fuel injection variable
Speed•
acceleration
Steering angle
Fuel injection apparatus
Evaluation value
Control device
Trim angle variable

FIG. 20

001021 "Hetz2260

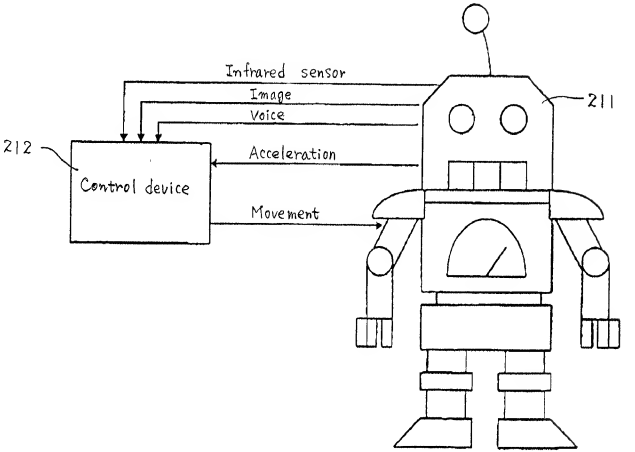


FIG. 21

00102"1e12e2e0

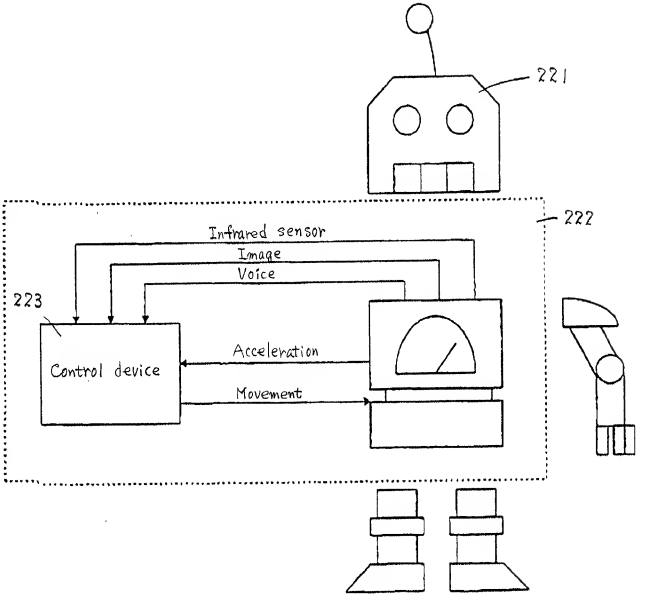


FIG. 22

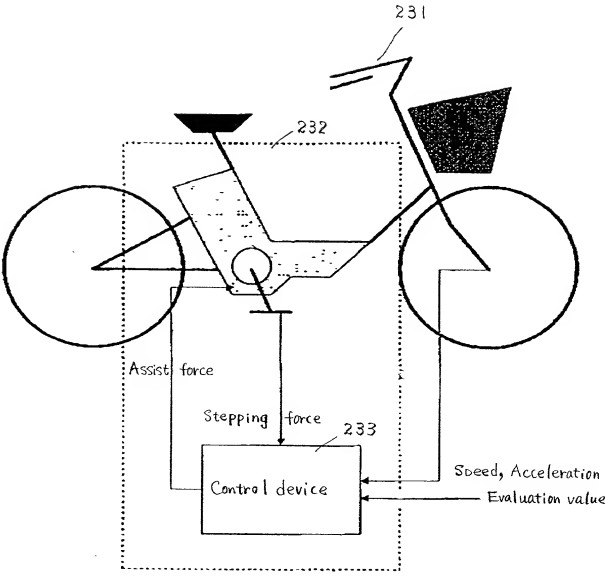

231
232
Assist force
Stepping force
233
Control device
Speed, Acceleration
Evaluation value

FIG. 23